Bedrock and Internal Ice Stratigraphy Along the 2002 US-ITASE Traverse: Byrd Camp to South Pole

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The 2002 US-ITASE traverse explored a broad range of glaciological environments from the upper reaches of the Ross Sea Ice Streams to the Bottleneck of the Transantarctic Mts., Hercules Dome, and the East Antarctic plateau. The 3 MHz radar data collected along the route revealed a number of features that reinforce the view of a dynamic ice sheet responding to changes in climate and basal conditions.

Four parallel 40+ km profiles at 3 km spacing near Byrd Camp show disruptions in the internal ice stratigraphy beneath flow lines seen in the RadarSat mosaic, connecting "Mt. Resnik," a subglacial mountain that reaches to within 200 m of the ice surface, to the upper reaches of Ice Stream D. Within the disrupted stratigraphy is a significant cross-cutting reflector that breaks up the upper 800 m of stratigraphy about 35 km from Byrd Camp. This cross-cutting reflector is present in all four profiles and is buried deeper in the downstream profiles, indicating that the feature is not currently active, but is a remnant of an upstream process, related to flow around Mt. Resnik or may represent past changes in ice thickness over the mountain. A similar cross-cutting reflector is seen downstream from the Whitmore Mts near the center of the WAIS.

Deep radar profiles through the "Bottleneck" of the Transantarctic Mts. show ice up to 3000 m in thickness with very complex stratigraphy indicative of dynamic ice flow conditions and/or spatial accumulation patterns. The stratigraphy, particularly in the upper 1000 meters more closely resembles a fluvial stratigraphic column than typical parallel antarctic ice layers. Layers thicken and thin along the profile, often truncating in unconformities. The bedrock reflector fades completely from view for a few tens of kilometers at roughly 2700-3000 m depth. Bedrock at this depth is readily seen in other segments of the traverse indicating higher signal attenuation here. Increased strain due to restricted flow through the Bottleneck may warm the deeper ice and increase attenuation.

The geometry of Hercules Dome is discussed in a companion talk by Jacobel et al.

Between Hercules Dome and the South Pole the profile crossed a region of two bright reflectors seen in the O.S.U. ERS-1 mosaic of the continent. The GPS surface data show the ERS-1 reflectivity peak is related to the steepest north-facing slopes. Shallow and deep radar interpretations (Figure 1) show the brightest ERS-1 reflector to be a possible scour surface where surface snow deposits are stripped to a depth of 20-30 m as the ice flows over a large (1500+ m) subglacial mountain.

The effects of the scour are visible in the downstream ice to a depth of 600 m. The absence of the scour surface further downstream of the feature indicates either a change in the position of the scouring (due to prevailing winds or deposition), or thinning of the ice sheet to a threshold level where ice flow over the bedrock mountain creates a surface rise that encourages scour.

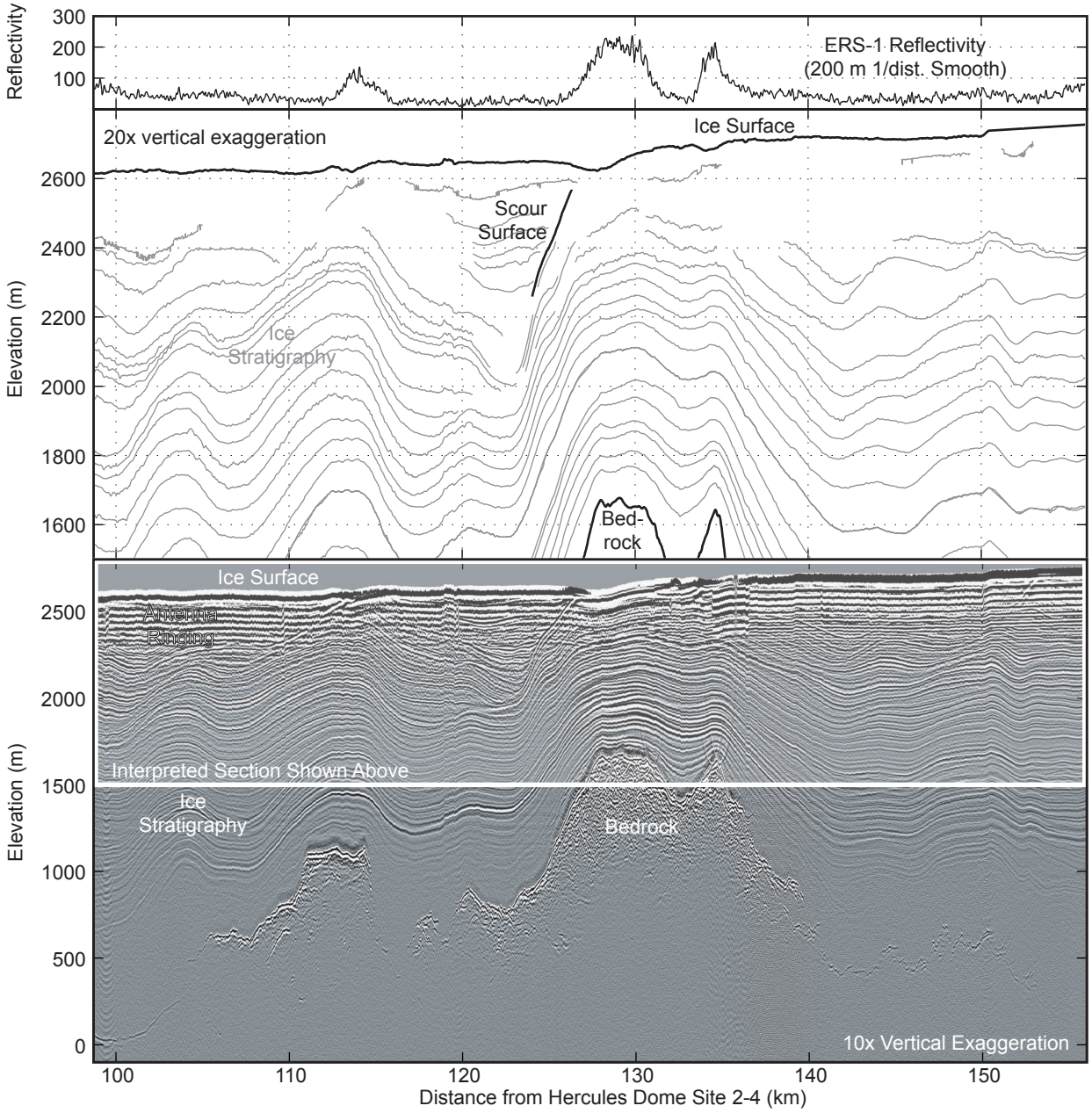

Figure 1: Processed and interpreted 3 MHz radar data from 2002 US-ITASE traverse showing the scour feature 20 km north of ice core site 02-5. Note the response of the ERS-1 reflectivity to the surface slope and the relationship of the ice surface slope to the truncated stratigraphy, interpreted here as scour by wind and subsequent reburial.